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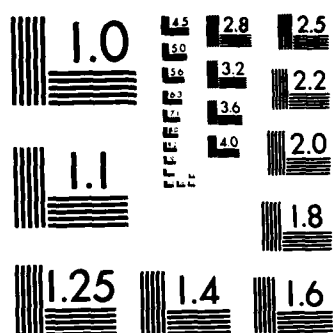
THE GORDON RESEARCH CONFERENCE ON MULTIPHOTON PROCESSES
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ENVIRONMENTAL RESEARCH DIV P M DEHMER ET AL 13 JUN 86
AFOSR-TR-86-2022 AFOSR-86-0186 F/G 7/5

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FINAL REPORT OF
THE GORDON RESEARCH CONFERENCE ON MULTIPHOTON PROCESSES

COLBY-SAWYER COLLEGE, NEW LONDON, NEW HAMPSHIRE

9-13 JUNE 1986

Grant Number AFOSR-86-0186

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Patricia M. Dehmer, Chairman
Argonne National Laboratory
Environmental Research Division
Argonne, Illinois 60439

Philip M. Johnson, Vice-Chairman
Department of Chemistry
State University of New York
at Stony Brook
Stony Brook, New York 11794

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MATTHEW J. KEEPER

Chief, Technical Information Division

Submitted by:

Name: Alexander M. Cruickshank
Signature: *Alexander M. Cruickshank*
Date: 10/2/86
Title: Director, Gordon
Research Conferences
Address: Gordon Research Center
University of Rhode Island
Kingston, RI 02881-0801
Telephone: (401) 783-4011, 783-3372

Name: Patricia M. Dehmer
Signature: *Patricia M. Dehmer*
Date: 25 August 1986
Title: Senior Chemist
Address: Environmental Research Div.
Argonne National Laboratory
Argonne, IL 60439
Telephone: (312) 972-4187

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The Third Gordon Research Conference on Multiphoton Processes was held at Colby-Sawyer College, New London, New Hampshire during the week 9-13 June 1986. The program of the Conference consisted of 21 invited talks, 66 contributed poster papers, and 7 brief oral "hot topic" presentations, which were chosen from among the contributed poster papers. In the tradition of Gordon Research Conferences, the scientific sessions were scheduled for mornings and evenings, leaving the afternoons free for discussions and/or recreational activities. The oral sessions were shortened on Monday and Wednesday evenings to allow for the late evening poster sessions. All of the oral sessions were well-attended (the sessions averaged 90-95 attendees) and the two poster sessions were very successful.

The program of ~~the Conference~~^s covered all aspects of Multiphoton Processes in atoms and molecules. There were sessions devoted to multiphoton ionization of atoms, multiphoton ionization in intense laser fields, multiphoton ionization and dissociation processes in small molecules, multiphoton dissociation processes in larger molecules (including picosecond processes), and general interest sessions. The complete Conference program is appended. ←

The Conference was heavily advertised via announcements in Science and in the newletters of the Division of Chemical Physics and the Division of Atomic, Molecular, and Optical Physics of the American Physical Society, by mailings to over 70 department heads of major chemistry departments, and by mailings to over 300 workers in the field of multiphoton processes. The Conference was attended by 105 scientists from the U.S., Canada, Europe, and Japan. This represents a significant increase in the attendance from previous years (54 in 1982 and 85 in 1984) and is due to the wide advertisement of the Conference and to the supplemental funding that the Conference received from the National Science Foundation and from the Air Force Office of Scientific Research. A complete list of attendees is appended.

The next Conference in this series will be held in 1988. The Chairman will be Professor Philip M. Johnson of the Department of Chemistry, the State University of New York at Stony Brook and the Vice-Chairperson will be Professor Peter Lambropoulos of the Department of Physics, University of Southern California.

The Conference budget of \$21,500 (\$10,500 from the Gordon Research Conferences, \$6,000 from the Air Force Office of Scientific Research, and \$5,000 from the National Science Foundation) was distributed in the following manner. The Conference registration fee, which included room and board for the week, was paid for all 28 Invited Speakers and Discussion Leaders. Partial travel support was granted to the Chairperson (who was also a Discussion Leader) and to the 9 Invited Speakers and Discussion Leaders from Europe and Japan; these disbursements amounted to \$11,625 or 54% of the total budget. The Conference registration fee was also paid for 21 graduate students and postdoctoral appointees; these disbursements amounted to \$5,775 or 27% of the total budget. Finally, partial travel and lodging support was given to 10 other attendees, 8 of whom were from Europe; these disbursements amounted to \$4,100 or 19% of the total budget. In summary, 59 attendees received partial support to attend the Conference, with a significant fraction of the budget used to support graduate students, postdoctoral appointees, and young scientists from the U.S. and abroad.

**PROGRAM OF THE
GORDON RESEARCH CONFERENCE
ON MULTIPHOTON PROCESSES**

**COLBY-SAWYER COLLEGE
NEW LONDON, NEW HAMPSHIRE**

9-13 JUNE 1986



**PATRICIA M. DEHMER, CHAIRMAN
PHILIP M. JOHNSON, VICE-CHAIRMAN**

Monday Morning, 9 June 1986

- Patricia M. Dehaer*, Argonne National Laboratory, Discussion Leader
- 8:50 Introduction by Conference Officials
- 9:30 *Steven D. Colson*, Yale University
"Multiphoton Ionization-Photoelectron Spectroscopic Studies of Molecular Excited States -- Structure and Dynamics"
- 10:20 Break
- 10:35 *Philip M. Johnson*, State University of New York at Stony Brook
"Multiphoton Ionization Spectroscopy of Radicals and Metastables"
- 11:25 *Robert M. Coapton*, Oak Ridge National Laboratory
"Multiphoton Ionization, Stimulated Electronic Raman Scattering, and Harmonic Generation in Dense Alkali Vapors"

Monday Afternoon, 9 June 1986

- 16:30 Poster Session I -- Sneak Preview

Monday Evening, 9 June 1986

- Steven D. Colson*, Yale University, Discussion Leader
- 19:30 *John E. M. Goldsmith*, Sandia National Laboratories
"Multiphoton Excitation Techniques for Combustion Diagnostics"
- 20:20 Hot Topic: *Robert P. Saxon*, *Douglas J. Bamford*, and *William K. Bischel*, SRI International
"Absolute Two-Photon Absorption Cross Sections in Atomic Oxygen: Agreement Between Theory and Experiment"
- 20:40 Poster Session I -- Program is appended

Tuesday Morning, 10 June 1986

- Edward R. Grant*, Purdue University, Discussion Leader
- 9:00 *Ahmed Zewail*, California Institute of Technology
"Picosecond and Femtosecond Multiphoton Mass Spectrometry"
- 9:50 *Curt Wittig*, University of Southern California
"Controlling Initial Geometries in Reactive and Inelastic Scattering"
- 10:40 Break
- 10:55 *Richard Bersohn*, Columbia University
"Competition Between Photodissociation and Photoionization in CH₃I"
- 11:45 Hot Topic: *J. Hossainlopp*, *D. Rooney*, *B. Samoriski*, and *J. Chaiken*, Syracuse University
"MPD/MPV of Organometallic Molecules - The Role of Nonradiative Processes in Determining Free Metal State Distributions"

Tuesday Evening, 10 June 1986

- Stephen J. Smith*, Joint Institute for Laboratory Astrophysics, Discussion Leader
- 19:30 *Gerard Mainfray*, Centre d'Etudes Nucleaires de Saclay, France
"Electron Energy Spectra in Multiphoton Ionization of Atoms"
- 20:20 *Peter Lambropoulos*, University of Southern California
"Collectivization versus Laissez-Faire Photon Absorption: The Atom's Dilemma Under a Pulsed Strong Laser"
- 21:10 Hot Topic: *P. H. Bucksbaum*, *R. R. Freeman*, AT&T Bell Laboratories, *T. J. McIlrath*, University of Maryland, and *M. Bashkanskyy*, Columbia University
"Multiphoton Ionization and Pondermotive Forces"

Wednesday Morning, 11 June 1986

- William A. Chupka*, Yale University, Discussion Leader
- 9:00 *Stephen T. Pratt*, Argonne National Laboratory
"Multiphoton Ionization of Diatomic Molecules"
- 9:50 *Michael N. R. Ashfold*, Bristol University, Bristol, England
"Rydberg States and Spectroscopy of NH₃"
- 10:40 Break
- 10:55 *Jeffrey M. Hudegens*, National Bureau of Standards
"Resonantly Enhanced Multiphoton Ionization Spectroscopy of Reactive Intermediates"
- 11:45 Hot Topic: *S. N. Dixit*, *D. L. Lynch*, *H. Rudolph*, and *V. McKoy*, California Institute of Technology
"Theoretical Studies of REMPI Processes in Diatomic Molecules"

Wednesday Afternoon, 9 June 1986

- 16:30 Poster Session II -- Sneak Preview

Wednesday Evening, 11 June 1986

- Katsumi Kimura*, Institute for Molecular Science, Okazaki, Japan, Discussion Leader
- 19:30 *H. B. van Linden van den Heuvel*, FOM - Institute for Atomic and Molecular Physics, Amsterdam, The Netherlands
"Resonantly Enhanced Multiphoton Ionization of Highly Excited and Continuum States in Atoms and Molecules"
- 20:20 Hot Topic: *J. Applig*, *M. G. White*, *W. J. Kessler*, *R. Fernandez*, and *E. D. Poliakov*, Brookhaven National Laboratory
"Photoionization of Aligned Molecular Excited States"
- 20:40 Poster Session II -- Program is appended

Thursday Morning, 12 June 1986

Edward Schleg, Institut für Physikalische und Theoretische Chemie der Technischen Universität München, Munich, West Germany, Discussion Leader

9:00 Stephen C. Wallace, University of Toronto, Toronto, Canada
"Multiphoton Ionization Spectroscopy of Jet-Cooled Molecules and van der Waals Clusters"

9:50 A. Welford Castleman, Jr., Pennsylvania State University
"Shedding Some Light on Clusters: An Exciting Process"

10:40 Break

10:55 Paul Houston, Cornell University

"Multiphoton Ionization Detection of the Fragments of Photo-dissociation"

11:45 Hot Topic: John C. Miller, Oak Ridge National Laboratory

"Multiphoton Spectroscopy and Photophysics of van der Waals Clusters"

Thursday Evening, 12 June 1986

Thomas Gallagher, University of Virginia, Discussion Leader

19:30 Karl Welge, Universität Bielefeld, Bielefeld, West Germany

"Multiphoton Ionization of Atoms"

20:20 R. Stephen Berry, University of Chicago

"Exploring Electron Correlations in Excited States by Resonant Multiphoton Ionization - Energy and Angular Distributions"

21:10 Hot Topic: M. Sander, L. A. Chewer, and Klaus Müller-Pethlefs,
Institut für Physikalische und Theoretische Chemie der Technischen Universität München, Munich, West Germany,

"Rotationally Resolved Zero Kinetic Energy Photoelectron Spectroscopy of Nitric Oxide"

Friday Morning, 13 June 1986

Philip M. Johnson, State University of New York at Stony Brook, Discussion Leader

9:00 Yohji Achiba, Institute for Molecular Science, Okazaki, Japan

"Multiphoton Ionization-Photoelectron Spectroscopic Studies on Dynamics of Excited Molecules"

9:50 Hans J. Neusser, Institute für Physikalische und Theoretische Chemie der Technischen Universität München, Munich, West Germany

"Doppler-Free Two-Photon Excitation and Intramolecular Dynamics"

10:40 Break

10:55 James Reilly, Indiana University

"Intensity Dependence of Laser Mass and Photoelectron Spectra"

POSTER SESSION I - MONDAY EVENING

- M1** Inverse Half-Bremsstrahlung in Multiphoton Ionization of Atoms in Intense Light Beams
Joseph Kupersztich (Service de Physique des Atomes et des Surfaces, CEN, Saclay)
- M2** Multiphoton Simple and Double Ionization of Strontium: An Electron Spectroscopy Study
Guillaume Petite and *Pierre Agostini* (Service de Physique des Atomes et des Surfaces, CEN, Saclay)
- M3** Absorption and Emission of Photons by Electronic Continuum States of Atomic Hydrogen and Xenon
H. B. van Linden van den Heuvell, *H. G. Muller*, and *M. J. van der Wiel* (FOM Institute for Atomic and Molecular Physics)
- M4** Photoelectron Spectroscopy of Above-Threshold Ionization of Xenon with Linearly and Circularly Polarized Light
R. Hippler, *H. Schwier*, *H.-J. Humpert*, and *H. O. Lutz* (University of Bielefeld)
- M5** Multiphoton Ionization and Ponderomotive Forces
P. H. Bucksbaum, *R. R. Freeman* (AT&T Bell Laboratories), *T. J. McIlrath* (University of Maryland), and *M. Bashkansky* (Columbia University)
- M6** Multiphoton Ionization of Xe and Kr: An Investigation of the Autoionizing Region Between the $2p_{1/2}$ and $2p_{3/2}$ Thresholds
J. A. D. Stockdale (Oak Ridge National Laboratory), *T. Efthymiopoulos*, and *C. Potakis* (Research Center of Crete)
- M7** Four-Photon Rydberg Series Converging to the $2p_{3/2}$ and $2p_{1/2}$ Limits in Xenon and Krypton
C. Potakis, *T. Efthymiopoulos* (Research Center of Crete), *P. R. Blazewicz*, *J. A. D. Stockdale*, and *John C. Miller* (Oak Ridge National Laboratory)
- M8** Two-Color Studies in Rare Gases: Striking Effects in Multiphoton Ionization and Third-Harmonic Generation
P. R. Blazewicz, *M. G. Payne*, *M. R. Garrett*, and *John C. Miller* (Oak Ridge National Laboratory)
- M9** Third-Harmonic Generation and Resonant Multiphoton Ionization
Michel Poirier (Service de Physique des Atomes et des Surfaces, CEN, Saclay)
- M10** Two Photon Ionization of Metastable Helium
H. Haberland, *J. Hühne*, *M. Oschwald*, and *J. Broad* (Universität Freiburg)
- M11** Multiple Charged Ions by Multiphoton Absorption Through Autoionizing States. A Model Calculation in Carbon
X. Tang and *P. Lambropoulos* (University of Southern California)
- M12** Absolute Two-Photon Absorption Cross sections in Atomic Oxygen: Agreement Between Theory and Experiment
Roberta P. Saxon, *Douglas J. Bamford*, and *William K. Bischel* (SRI International)
- M13** Photoelectron Angular Distributions Across Autoionizing Resonances in Barium
James S. Keller, *John E. Hunter III*, and *R. Stephen Berry* (University of Chicago)
- M14** Two Laser Field Ionization Spectroscopy of High Lying Rydberg Series of Second Row Transition Metal Atoms
D. M. Rayner, *S. A. Mitchell*, and *P. A. Hockett* (National Research Council Canada)
- M15** Quantum Interference in Two Photon Absorption: Polarization and Magnetic Field Effects in the $(7s)S + (5s)^2S$ Transition of Atomic Sr
R. B. Stewart and *G. J. Diebold* (Brown University)
- M16** Aspects of the Jacobi-Matrix Method: Double Photoionization and Photoionization in a Magnetic Field
P. C. Ojha (University of Chicago)
- M17** The Berson Model in Multiphoton Ionization
Miodrag Janjusevic and *Marvin H. Mittleman* (The City College of the City University of New York)
- M18** Determination of Population and Alignment Using Two-Photon Nonresonant Excitation
Andrew C. Kummel, *Greg O. Sitz*, and *Richard N. Zare* (Stanford University)
- M19** Multiphoton Spectroscopy and Photophysics of van der Waals Clusters
John C. Miller, (Oak Ridge National Laboratory)
- M20** Multiphoton Studies of High Excited States of Acetylene
Thomas M. Orlando, *Scott L. Anderson* (State University of New York at Stony Brook), *Jeffrey R. Appling*, and *Michael G. White* (Brookhaven National Laboratory)
- M21** Direct Characterization of the Internal Energy Distribution of the CH_2 Photofragment Produced by Coherent VUV Photolysis of CH_4
Paul J. Miller and *William A. Chupka* (Yale University)
- M22** Multiphoton Spectroscopy of Small Hydrocarbon Radicals in a Supersonic Jet with Mass and Photoelectron Analysis
Peter Chen, *Steven D. Colson*, *William A. Chupka*, *Joan B. Pallix*, and *Jerome A. Berson* (Yale University)

M23 REMPI Photoelectron Spectroscopy of H₂S in the Wavelength Region 425-475 nm

S. Keith Cole, Jhobe Steadman, and Tomas Baer (University of North Carolina)

M24 State-Selective Two-Photon Dissociation of NO₂: Dynamics and Polarization Spectroscopy

Larry Bigio and Edward R. Grant (Cornell University)

M25 Multiphoton Ionization Spectroscopy of HCO and DCO and Dynamics of Acetaldehyde Photolysis

Douglas A. Webb, Paul J. H. Tjossem, Terrill A. Cool, and Edward R. Grant (Cornell University)

M26 Photodissociation of Methyl Iodide

Rachel Ogorzalek, Han-Peter Haerri, Man-Yee Cheung, and Paul L. Houston (Cornell University)

M27 Photofragment Spectroscopy with Coherent Vacuum Ultraviolet

Irene M. Waller, H. Floyd Davis, and John W. Hepburn (University of Waterloo)

M28 SARISA III: A High-Transmission Multiple-Focusing TOF Spectrometer Utilizing a Resonance Ionization Source

C. E. Young, M. J. Pellin, W. F. Calaway, E. L. Schweitzer, B. Jørgensen, J. W. Burnett, and D. M. Gruen (Argonne National Laboratory)

M29 Multiphoton Processes at Crystal Surfaces

J. Reif, H. B. Nielsen, O. Semmler, P. Tepper, E. Fridell, E. Westin, A. Rosén, and E. Matthias (Free University of Berlin)

M30 Infrared Multiphoton Photooxidation of NH₂D on Solid Surfaces

Chhiu-Tsu Lin (Northern Illinois University)

M31 Saturation of an Atomic Transition by a Phase Diffusing Laser Field

D. S. Elliott (Purdue University), M. W. Hamilton, K. Arnett, and S. J. Smith (JILA, University of Colorado, and NBS)

M32 Above-Threshold Ionization without Space-Charge

Francois Yergeau, Guillaume Petite, and Pierre Agostini (Service de Physique des Atomes et des Surfaces, CEN, Saclay)

M33 Multichannel Multiphoton Processes in Strontium Vapor

J. Reif, K. Bohmer, and E. Matthias (Free University of Berlin)

M34 Measurement of ⁹Be - ¹⁰Be Isotope Shifts by Doppler-Free Resonance Ionization Mass Spectrometry

Jesse Men, B. Carol Johnson, J. C. Travis, T. B. Lucatorto, and C. W. Clark (National Bureau of Standards)

M35 Quantum Defect Theory Calculations of Multiphoton Excitation and Ionization Cross Sections in O Atoms

S. N. Dixit, D. Levin, and V. McKoy (California Institute of Technology)

POSTER SESSION II - WEDNESDAY EVENING

W1 Quantum Beats in Atomic Fluorescence Excited by Molecular Photodissociation

Gerald J. Diebold (Brown University)

W2 Resonant Multiphoton Ionization of H₂ via the E,F ¹r_g⁺ State. Absorption of Photons in the Ionization Continuum

C. Cornaggia, D. Normand, J. Morellec, G. Mainfray, and C. Manus (Service de Physique des Atomes et des Surfaces, CEN, Saclay)

W3 Inclusion of Strong Fields Effects in Quantum Defect Treatments of Molecular Processes

Annick Giusti-Suzor, Christian Jungen, and Peter Zoller (Laboratoire de Photophysique Moléculaire, Université de Paris-Sud)

W4 High Resolution Multiphoton Laser Spectroscopy of Excited States of H₂

E. F. McCormack and E. E. Syler (Yale University)

W5 High Resolution Studies of States of Molecular Hydrogen Near the First Ionization Limit

Wallace L. Glab and Jan P. Hessler (Argonne National Laboratory)

W6 Photoelectron Energy Analysis Following Resonantly Enhanced Multiphoton Ionization of H₂ via the C ¹Π State

M. A. O'Halloran, S. T. Pratt, J. L. Dehmer, and P. M. Dehmer (Argonne National Laboratory)

W7 Theoretical Studies of REMPI Processes in Diatomic Molecules

S. N. Dixit, D. L. Lynch, H. Rudolph, and V. McKoy (California Institute of Technology)

W8 (2 + 1) Resonant Enhanced Multiphoton Ionization of H₂ via the E,F ¹r_g⁺ State

H. Rudolph, D. L. Lynch, S. N. Dixit, and V. McKoy (California Institute of Technology)

W9 Autoionization of Nonpenetrating Rydberg States in Diatomic Molecules

E. E. Syler (Yale University)

W10 s and d Rydberg Series of NO Probed by Double Resonance Multiphoton Ionization: Multichannel Quantum Defect Analysis

Susanne Fredin, Dolores Gauyacq, Marcel Horani, Christian Jungen, and Françoise Masnou (Laboratoire de Photophysique Moléculaire, Université de Paris-Sud)

W11 Rotationally Resolved Double Resonance Spectra of NO Rydberg States Near the First Ionization Limit

D. T. Biernacki, S. D. Colson, and E. E. Syler (Yale University)

W12 Asymmetric Lineshapes Associated with Predissociating Levels of NO(E ²r_g⁺)

M. N. R. Ashfold, R. N. Dixon, J. D. Prince, B. Titcher, and C. N. Western (University of Bristol)

- W13 Photoionization of Aligned Molecular Excited States
J. Applling, M. G. White, W. J. Kessler, R. Fernandez, and E. D. Poliakoff (Brookhaven National Laboratory)
- W14 Rotationally Resolved Zero Kinetic Energy Photoelectron Spectroscopy of Nitric Oxide
M. Sander, L. A. Chewter, and K. Müller-Dethlefs (Technische Universität München)
- W15 2 and 3 Photon REMPI Spectroscopic Investigations of Acetone and *cis*-Hexatriene
R. McDiarmid and A. Sabljic (National Institutes of Health)
- W16 Semiclassical Quantization of a Classical Analog to the Jahn-Teller $E \times e$ System
Josef W. Zwanziger, Edward R. Grant, and Gregory S. Ezra (Cornell University)
- W17 Polarization Studies of $2 + 1$ REMPI Transitions in Cyclo-Alkenes and Methyl Cyclopentane
Tim Cornish and Tomas Baer (University of North Carolina)
- W18 Photodissociation of Energy Selected $C_4H_6^+$ Ions: The Isomerization Barrier Between Butyne and 1,3 Butadiene Ion Isomers
Thomas L. Bunn and Tomas Baer, (University of North Carolina)
- W19 Determination of Unimolecular Ionic Formation Rates by Pulsed Laser Linear-Reflection Time-of-Flight Mass Spectrometry
Tsong-Lin Tai and M. A. El-Sayed (University of California at Los Angeles)
- W20 A New Technique for the Determination of the Relative Kinetic Energy Release in Laser Multiphoton Ionization Fragmentation
Tsong-Lin Tai and M. A. El-Sayed (University of California at Los Angeles)
- W21 Ion Dip Spectroscopy and Multiresonant Processes in Aromatic Molecules by Molecular Beam Mass Spectroscopy
Jack A. Svage and John E. Wessel (The Aerospace Corporation)
- W22 Reaction Dynamics from Higher Excited Electronic States by Molecular Beam Multiphoton Ionization
Jack A. Svage, James E. Pollard, and Ronald B. Cohen (The Aerospace Corporation)
- W23 Nonlinear Photochemistry of Organic Molecules
Joseph L. BelBruno (Dartmouth College)
- W24 The Laser Photoelectron Spectrum of Gas Phase *p*-Difluorobenzene
Ellen Sekreta, K. S. Viswanathan, and James P. Reilly (Indiana University)
- W25 Semiclassical Time Dependent Theory of Two-Photon Spectroscopy. The Effect of Dephasing in the Virtual Level on the Two-Photon Excitation Spectrum of Iso-Tachysterol
Robert A. Birge (Carnegie-Mellon University) and *Brian M. Pierce* (Hughes Aircraft Company)
- W26 Valence-Rydberg Double Resonance Spectroscopy in Sym-Triazine
Kenneth Haber and E. R. Grant (Cornell University)
- W27 MPD/MP1 of Organometallic Molecules - The Role of Nonradiative Processes in Determining Free Metal State Distributions
J. Hossenlopp, D. Rooney, B. Samoriski, and J. Chaiken (Syracuse University)
- W28 Collisional Effects in the MPI of Organometallic Molecules
J. Hossenlopp and J. Chaiken (Syracuse University)
- W29 Multiphoton Ionization and Fragmentation of C_7H_8O and $C_6H_{10}O$ Structure Isomers
Ta-Chau Chang and Murray V. Johnston (CIRES, University of Colorado)
- W30 Unimolecular Decay Rates and Kinetic Isotope Effects of Energy Selected Benzene Cations in a Reflectron Mass Spectrometer
H. Kühlewind, A. Kiermeier, H. J. Neusser, and E. W. Schlag (Technische Universität München)
- W31 CARS Detection of Infrared Multiphoton Excitation
Mary Jane Shultz, Robert E. Tricca, L. M. Yam, S. L. Bevetz, Mei Jian, and Christopher Kostas (Massachusetts Institute of Technology)

GORDON RESEARCH CONFERENCES

ON

MULTIPHOTON PROCESSES

June 9-13, 1986

Colby-Sawyer College, N.H.
(South Site)

Dr. Patricia M. Dehmer, Chairman
Dr. Philip M. Johnson, Vice President

Yohji Achiba Tokyo Metropolitan Univ. Department of Chemistry Setagaya-Ku Tokyo 158, JAPAN	P-303	Dr. Richard Bersohn Columbia University 959 Havemeyer Hall New York, NY 10027	C-209
Scott L. Anderson State Univ. of New York Dept. of Chemistry Stony Brook, NY 11794	P-306	Dr. Dorothea T. Biernacki Yale University Dept. of Chemistry 225 Prospect St., Box 6666 New Haven, CT 06511	C-103
Jeffrey R. Appling Brookhaven National Laboratory Chemistry Department 33 Lewis Road, Bldg. 555 Upton, NY 11973	P-200	Dr. Larry Bigio Cornell University Dept. of Chemistry, Box 15 Ithaca, NY 14853	P-212
Dr. Ashfold University of Bristol School of Chemistry Bristol, UNITED KINGDOM	P-306	Dr. Perry R. Blazewicz Oak Ridge National Laboratory Bldg. 4500-S, Rm. S116 P.O. Box X Oak Ridge, TN 37831	P-303
Dr. Tomas Baer Univ. of North Carolina Chemistry Department Chapel Hill, NC 27514	C-209	Dr. Peter D. Brewer Hughes Research Laboratories RL62 3011 Malibu Canyon Road Malibu, CA 90265	P-202
Dr. Joseph H. Belbruno Dartmouth College Department of Chemistry Steele Hall Hanover, NH 03755	P-203	Dr. Phil H. Bucksbaum AT&T Bell Laboratories Rm. 10466 600 Mountain Avenue Murray Hill, NJ 07974	P-204
Dr. Sue Berets Tufts University Chemistry Department Pearson Laboratory Medford, MA 02155	P-101	Dr. A. Welford Castleman, Jr. Pennsylvania State University Dept. of Chemistry 152 Davey Laboratory University Park, PA 16802	P-206
Dr. Stephen Berry University of Chicago Dept. of Chemistry 5735 So. Ellis Avenue Chicago, IL 60637	P-201	Dr. Joseph Chaiken Syracuse University Chemistry Department 108 Bowne Hall Syracuse, NY 13210	M-10

Dr. Ta-Chau Chang Cooperative Inst. for Research In Environmental Sciences Campus Box 449 Boulder, CO 80302	P-208	Dr. Gerald Diebold Brown University Chemistry Department Providence, RI 02912	P-300
Dr. Peter Chen Yale University Dept. of Chemistry 225 Prospect Street New Haven, CT 06511	C-214	Dr. S. N. Dixit California Institute of Tech. Dept. of Chemistry, 127-72 Pasadena, CA 91125	P-207
Dr. Wan Yee Cheung Geo-Centers Inc. 315 Richard Mine Road Wharton, NJ 07885	C-203	Dr. Tom Efthimopoulos University of Crete Physics Department Iraklion Crete, GREECE	P-209
Dr. William A. Chupka Yale University Dept. of Chemistry Box 6666 New Haven, CT 06511-8118	C-214	Dr. Ulrich Eichmann University of Virginia Physics Department McCormick Road Charlottesville, VA 22901	C-204
Dr. Ronald Bruce Cohen Aerospace Corporation P.O. Box 92957 Los Angeles, CA 90009	B-319	Dr. Dan Elliott Purdue University School of Electrical Engineering West Lafayette, IN 47907	C-303
Dr. Steven D. Colson Yale University Dept. of Chemistry 225 Prospect Street New Haven, CT 06511	C-100 A	Dr. Edward Eyler Yale University Physics Department 217 Prospect Street New Haven, CT 06511	P-304
Dr. Robert N. Compton Oak Ridge National Lab. Health & Safety Res. Div. P.O. Box X Oak Ridge, TN 37831	P-301	Dr. Robert W. Farley Pennsylvania State University 152 Davey Laboratory University Park, PA 16802	C-204
Mr. Timothy J. Cornish Univ. of North Carolina Chemistry Department Chapel Hill, NC 27514	C-212	Dr. C. Fotakis Research Center of Crete P.O. Box 1527 Iraklion 71110 Iraklion, Crete GREECE	P-209
Dr. Patricia M. Dehmer Argonne National Laboratory Building 203-Room C153 Argonne, IL 60439	P-100 (Suite)	Dr. Thomas Gallagher University of Virginia Charlottesville, VA 27901	B-313
Dr. C. A. Delange Free University Dept. of Physical Chemistry De Boelelaan 1083 Amsterdam 1081 HV THE NETHERLANDS	C-212	Dr. Dolores Gauyacq CNRS Lab. De Photophysique Moleculaire Bat. 213, Universite de Paris-SUD Orsay 91405, FRANCE	B-101

Dr. Barry Gelernt Process Technology Ltd. 281 Restigouche Road Oromocto, New Brunswick E2V 2H2 CANADA	C-203	Dr. Miodrag Janjusevic City College of City Univ. of NY Physics Department 137th Street & Convent Avenue New York, NY 10031	C-206
Dr. Annick Giusti Universite Paris-SUD Labor. PPM-Bat. 213 Orsay F91405, FRANCE	P-103	Dr. Philip M. Johnson State University of New York Department of Chemistry Stony Brook, NY 11794	C-202
Dr. Wallace L. Glab Argonne National Laboratory Chemistry Division Bldg. 200, K-121 Argonne, IL 60439	C-210	Dr. James S. Keller University of Chicago Dept. of Chemistry 5735 South Ellis Avenue Chicago, IL 60627	C-206
Dr. John E. M. Goldsmith Sandia National Laboratories Division 8354 Livermore, CA 94550	P-305	Dr. Katsumi Kimura Institute for Molecular Science Myodaiji, Okazaki, 444 JAPAN	C-304
Dr. E. R. Grant Cornell University Baker Laboratory Ithaca, NY 14853	C-301	Mr. Andrew C. Kummel Stanford University Dept. of Chemistry Stanford, CA 94305	C-302
Dr. Kenneth Haber Cornell University Dept. of Chemistry Box 182 Ithaca, NY 14853	C-210	Dr. Joseph Kupersztych Centre D'Etude Nucleaires de Saclay Service de Physique des Atomes & Surface C.E.N. Saclay 91121 GIF-SUR-YVET, FRANCE	M-6
Dr. Rainer Hippler University of Bielefeld Faculty of Physics Universitaetsstr. 25 D-4800 Bielefeld, WEST GERMANY	B-317	Dr. P. Lambropoulos University of So. California Physics Department Los Angeles, CA 90089-0484	P-207
Dr. Jeanne M. Hossenlopp Syracuse University Dept. of Chemistry 108 Bowne Hall Syracuse, NY 13244-1200	C-208	Dr. Chiu-Tsu Lin Northern Illinois University Dept. of Chemistry Dekalb, IL 60115	C-302
Dr. Paul L. Houston Cornell University Baker Laboratory of Chemistry Ithaca, NY 14853	C-306	Dr. S. Randolph Long U.S. Army Chemical Res. & Dev. Center Mail Stop SMCCR-RSL Aberdeen Pvg. Ground, MD 21010-5423	C-310
Dr. Jeffrey W. Hudgens National Bureau of Standards Chemical Kinetics Division Gaithersburg, MD 20850	P-210	Dr. Gerard Mainfray CEA Service de Physique Atomique Cen Saclay, Gif-Sur-Yvette 911 FRANCE	C-310

Dr. Elizabeth McCormack Yale University Sloane Physics Lab. Prospect Street New Haven, CT 06511	C-103	Dr. Cheuk-Yiu Ng Iowa State University Dept. of Chemistry Ames, IA 50011	M-2
Dr. Ruth McDairmid National Inst. of Health Bldg. 2, Room B1-07 Bethesda, MD 20892	C-106	Dr. Rachel Ogorzalek Cornell University Baker Laboratory Ithaca, NY 14853	C-101
Dr. J. D. McDonald University of Illinois Dept. of Chemistry 505 South Mathews Avenue Urbana, IL 61801	P-210	Dr. Maureen O'Halloran Argonne National Laboratory ER 203-C 161 Argonne, IL 60439	C-102
Dr. John C. Miller Oak Ridge National Laboratory Health & Safety Research Division P.O. Box X Oak Ridge, TN 37831	P-302	Dr. P. C. Ojha University of Chicago Dept. of Chemistry 5735 South Ellis Avenue Chicago, IL 60637	M-14
Dr. Paul J. Miller Yale University Sterling Chemistry Laboratory 225 Prospect Street New Haven, CT 06511	M-2	Dr. Thomas M. Orlando State University of New York Department of Chemistry Stony Brook, NY 11794	P-200
Dr. Robert J. Miller Michigan Technological Univ. Department of Chemistry Houghton, MI 49931	M-13	Dr. Michael Oswald Universitat Freiburg Fakultat fur physik Herrmann Herderstr. 3 D-7800 Freiburg WEST GERMANY	M-6
Dr. Marvin Mittleman Physics Department The City College New York, NY 10031	B-309	Dr. Charles E. Otis IBM Corporation Dept. T-37, Bldg. 257-3 1701 N. Street Endicott, NY 13760	B-309
Dr. Robert J. Moore Virginia Commonwealth Univ. Department of Chemistry VCU Box 2006 Richmond, VA 23284	C-305	Dr. Guillaume Petite DPHG/SPAS-Cen Saclay 91191 Gif-sur-Yvette, FRANCE	B-313
Dr. Klaus Muller-Dethlets Institut fur Physikalische Chemie Tu Munchen Lichtenbergstrasse 4 D-8046 Garching, WEST GERMANY	C-207	Dr. Brian M. Pierce Hughes Aircraft Company Bldg. A-1, M/S 3C 923 P.O. Box 9399 Long Beach, CA 90810	C-305
Dr. H. J. Neusser Technische Universitat Munchen Institut fur Physikalische Chemie Lichtenbergstr. 4 D-8046 Garching, WEST GERMANY	M-18	Dr. Michel Poirier C. E. A. Service de Physique des Atomes & Des Surfaces Gif-Sur-Yvette 911, FRANCE	M-7
		Dr. Stephen T. Pratt Argonne National Lab. Bldg. 203 C-141 9700 S. Cass Avenue Argonne, IL 60439	M-15

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|--------------------------------------------------------------------------------------------------------------------------------------------------------|-------|---------------------------------------------------------------------------------------------------------------------------------------------|-------|
| Dr. David M. Rayner
National Research Council of
Canada
Division of Chemistry
100 Sussex Drive, Ottawa
Ontario, Canada K1A 0R6 | M-12 | Dr. Mary Jane Shultz
Massachusetts Inst. of Technology
Rm. 6-006, Spectroscopy Lab.
77 Massachusetts Avenue
Cambridge, MA 02139 | P-101 |
| Dr. Juergen Reif
Free University Berlin
FB Physik
Arnimallee 14
D-1000 Berlin 33
WEST GERMANY | M-16 | Dr. Stephen J. Smith
University of Colorado
JILA
Campus Box 440
Boulder, CO 80309-0440 | C-303 |
| Dr. James P. Reilly
Indiana University
Dept. of Chemistry
Bloomington, IN 47405 | M-1 | Dr. Jhobe Steadman
University of North Carolina
Dept. of Chemistry
Venable Hall, 045A
Chapel Hill, NC 27514 | M-11 |
| Dr. Henrik Rudolph
California Institute of Technology
Dept. of Chemistry-MC 127/72
1201 E. California Blvd.
Pasadena, CA 91125 | M-5 | Dr. P. K. Swaminathan
Chemical Dynamics Corporation
1550 West Henderson Road
Suite N-133
Columbus, OH 43220 | M-11 |
| Dr. Edward B. Saloman
National Bureau of Standards
Photon Physics Group-Radiation Phys. Div.
A-251 Physics Building
Gaithersburg, MD 20899 | C-201 | Dr. Jack A. Syage
Aerospace Corporation
Aerophysics Lab.
P.O. Box 92957, MS M2-253
Los Angeles, CA 90009 | B-303 |
| Mrs. Ora F. Saloman
(Guest of Dr. Edward Saloman) | C-201 | Dr. Tsong-Lin (Leo) Tai
UCLA
Dept. of Chemistry & Biochem.
Los Angeles, CA 90024 | C-207 |
| Dr. Roberta P. Saxon
SRI International - PN093
333 Ravenswood Avenue
Menlo Park, CA 94025 | C-104 | Dr. Xian Tang
Univ. of Southern California
Dept. of Physics
Los Angeles, CA 90089-0484 | M-7 |
| Dr. Edward W. Schlag
Technische Universitat Munchen
Institut fur Physikalische Chemie
Lichtenbergstr. 4
Garching D-8046, WEST GERMANY | M-17 | Dr. Karen Trentelman
Cornell University
Baker Lab., Chemistry
Ithaca, NY 14853 | C-101 |
| Ms. Ellen Sekreta
Indiana University
Dept. of Chemistry
Bloomington, IN 47405 | C-102 | Dr. H. B. Van L. Van Den Heuvel
Fom-Institut fur Atomic & Molec. Phy.
Kruislaan 407, Amsterdam 1098 SJ
THE NETHERLANDS | B-305 |
| Dr. Steven W. Sharpe
SUNY at Stony Brook
Dept. of Chemistry
Stony Brook, NY 11794 | M-1 | Dr. S. C. Wallace
University of Toronto
Dept. of Chemistry
Toronto, Ontario M5S 1A1 CANADA | B-307 |
| | | Dr. Irene Waller
University of Waterloo
Dept. of Chemistry, Bldg. C2
Waterloo, Ontario N2L 3G1 CANADA | C-208 |

Dr. Valerie A. Walters C-106
State University of New York
Department of Chemistry
Stony Brook, NY 11794

Dr. K. H. Welge P-205
University of Bielefeld
WEST GERMANY

Dr. Jesse Wen M-8
National Bureau of Standards
Bldg. 222, Room A223
Gaithersburg, MD 20899

Dr. Curt Wittig B-315
University of So. California
Chemistry Department
Los Angeles, CA 90089-0484

Dr. Charles E. Young M-9
Argonne National Laboratory
CHM/MST Division
9700 South Cass Avenue
Argonne, IL 60439

Dr. Emily Yixie Xu C-104
University of Virginia
Physics Department
Charlottesville, VA 22901

Dr. Ahmed H. Zewail M-10
California Inst. of Technology
Dept. of Chemistry MC 127-72
1201 E. California Blvd.
Pasadena, CA 91125

Dr. Josef W. Zwanziger P-212
Cornell University
Dept. of Chemistry
Baker Laboratory
Ithaca, NY 14853

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